

## SUCTION OR BLOWING CYLINDER

CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** The present application is a National Stage Application of International Application No. PCT/EP2004/052892, filed on November 9, 2004. Further, the present application claims priority to German Patent Application No. 103 55 427.0, filed on November 27, 2003.

BACKGROUND OF THE INVENTION1. Field of the Invention

**[0002]** The invention relates to a suction or blowing cylinder of a machine for producing and/or shaping a paper, cardboard, tissue or another fibrous material. More particularly, the invention relates to a cylinder comprising a rotatable, perforated cylinder covering and at least one pressure area which is connected to a low pressure source or a high pressure source and is sealed in relation to the cylinder covering with the aid of at least one sealing element.

2. Discussion of Background Information

**[0003]** Low or high pressure zones, which are embodied in the form of a pressure compartment connected to a low pressure source or a high pressure source and adjoining a moving surface such as the cylinder covering, are utilized in different locations of a machine for producing a web of fibrous material (for example, in a paper machine in the forming section, in the press section and/or in the drying section). The pressure compartments may be utilized, for instance, within suction cylinders. These usually comprise fixed internal suction compartments which form zones of different pressure levels. Sealing of the low pressure

zones is accomplished by sealing elements, which, as a general rule, extend at least substantially along the complete length of the cylinder.

**[0004]** When the perforation on these cylinders gets out of the pressure area, the air pressure in the perforation and the outside pressure are equalized. As a result, air flows out of the perforation in the case of blowing cylinders and into the perforation in the case of suction cylinders. This air stream causes significant noise. Independently of that, air leaks in the region of the sealing elements can also lead to generation of noise.

**[0005]** To counter this noise, special sealing systems were developed in the area of the pressure compartment. Such known systems are, however, not sufficiently effective and/or too complex. A sealing system which prevents the generation of noise to a large extent is disclosed in German Patent Application No. DE 103 47 177.4.

**[0006]** In the known sealing system, an at least substantially air-tight cover, which runs in a circumferential direction and is located outside of the pressure compartment, adjoins at least one sealing element or is located in the proximity of a side wall of the at least one pressure compartment on the outside of the cylinder covering. The cover makes contact with the cylinder covering or is placed at a distance of less than 100 mm from the cylinder covering. The cover is either totally air tight or it allows air to pass through only to a small extent.

**[0007]** The known cover significantly prevents pressure equalization between the perforation and the inside of the cylinder. As a result, pressure equalization is essentially only possible with the external part of the cylinder or, depending on the design, essentially only possible with the inner part of the cylinder.

[0008] The sealing elements laterally separating the pressure compartment from the inner wall of the cylinder covering are constructed in the form of trims and pressed against the cylinder covering. The friction force generated between the sealing elements and the moving surface of the cylinder covering results in a high power requirement for driving the cylinder covering.

### SUMMARY OF THE INVENTION

[0009] The present invention provides a sealing device which reduces the friction force.

[0010] For a suction or blowing cylinder, this is achieved by the sealing element being embodied in a flat-shaped manner and being arranged in the vicinity of the inner wall of the cylinder covering.

[0011] According to aspects of the invention, a flat-shaped sealing element can be utilized in place of a trim-shaped sealing element, together with the cover adjacent thereto. A reduction in driving power is achievable in this way.

[0012] According to aspects of the invention, there is an embodiment of the plate-shaped sealing element wherein the distance between the inner wall of the cylinder covering and the sealing element is less than 1 mm.

[0013] The distance between the inner wall of the cylinder covering and the sealing element is less than 300 mm, preferably less than 50 mm.

[0014] According to further aspects of the invention, there is an embodiment wherein the distance between the inner wall of the cylinder covering and the sealing element is constant or it varies in axial direction and/or in circumferential direction (for example, undulating).

**[0015]** It is advantageous when the sealing element extends in an axial direction along the complete length of the suction or blowing cylinder or when it only extends along a partial length. In this case, the sealing element can also comprise a plurality of segments.

**[0016]** Further, the sealing element may extend in a circumferential direction along the complete inner surface of the suction or blowing cylinder covering or along almost the complete inner surface of the covering.

**[0017]** The sealing element may be secured by fastening it to holding elements provided in the vicinity of the inner surface of the suction or blowing cylinder covering. The holding elements are themselves joined to a stationary axis in the center of the suction or blowing cylinder, or they are fastened to the front side.

**[0018]** In a further advantageous embodiment of the invention, the sealing element is movably, e.g., pivotably, disposed in radial direction by at least one adjusting element.

**[0019]** The invention provides flat-shaped sealing elements, instead of the trim-shaped sealing elements known in the state of the art. This results in the vacuum area being separated from the normal pressure zone by long gaps of limited width, rather than narrow, short gaps. The sealing effect and the evacuation of the gaps between the sealing surfaces and the moving surface of the cylinder covering is achieved (in the case of the suction cylinder), in particular in the downward sealing area, by the residual vacuum in the open volumes and by the perforations of the moving surface, respectively. The long gaps of limited width can generate similar  $C_w$  values and thus a similar sealing effect as the usual short gaps. These statements also apply to a blowing cylinder. The application of the invention can result in a noticeable

reduction in the driving power required for the moving surface as a result of reduced friction forces (because of lacking solid friction).

**[0020]** In a first aspect of the invention, there is a cylinder, comprising a rotatable and perforated cylinder covering, at least one sealing element non-contactingly disposed near an inner wall of the cylinder covering, and at least one area sealed in relation to the cylinder covering by the at least one sealing element.

**[0021]** A distance between the inner wall and the at least one sealing element may be less than 300 mm. Alternatively, the distance may be less than 50 mm. Alternatively, the distance may be less than 1 mm.

**[0022]** A distance between the inner wall and the at least one sealing element is constant. Alternatively, the distance between the inner wall and the at least one sealing element varies in at least one of an axial direction and a circumferential direction.

**[0023]** The at least one sealing element extends in an axial direction along a complete length of the cylinder. Alternatively, the at least one sealing element extends in an axial direction along only a partial length of the cylinder.

**[0024]** The at least one sealing element extends in a circumferential direction along an entirety of the inner wall. Alternatively, the at least one sealing element extends in a circumferential direction along a majority of the inner wall.

**[0025]** The cylinder may further comprise holding elements fastening the at least one sealing element. The holding elements may be fastened to a fixed axis or a front side of the cylinder.

**[0026]** The cylinder may further comprise at least one adjusting element structured and arranged to pivot the at least one sealing element in a radial direction.

**[0027]** The sealing element may be embodied in a flat-shaped manner. The cylinder may be structured and arranged for suction or blowing in a machine for producing or shaping paper, cardboard, tissue, or other fibrous material. Moreover, the at least one pressure area is connected to one of a low pressure source and a high pressure source.

**[0028]** In a second aspect of the invention, there is a pressure cylinder comprising a rotatable and perforated cylinder covering, at least one sealing element non-contactingly disposed circumferentially near an inner wall of the cylinder covering, and a pressure compartment being fixed relative to the cylinder covering and sealed in relation to the cylinder covering by the at least one sealing element.

**[0029]** The at least one sealing element may comprise a first flat-shaped sealing element disposed along a first circumferential portion of the inner wall, and a second flat-shaped sealing element disposed along a second circumferential portion of the inner wall. The pressure cylinder may further comprise a first adjusting element structured and arranged to bend a first end of the first flat-shaped sealing element inward, a second adjusting element structured and arranged to bend a second end of the first flat-shaped sealing element inward, a third adjusting element structured and arranged to bend a first end of the second flat-shaped sealing element inward, and a fourth adjusting element structured and arranged to bend a second end of the second flat-shaped sealing element inward.

**[0030]** The at least one sealing element may extend along substantially all of a circumference of the inner wall except for a portion corresponding to a contact region of an

air-permeable belt. Moreover, the at least one sealing element may define the pressure compartment.

[0031] In a third aspect of the invention, there is a method of providing suction or blowing pressure to a fibrous web carried on an air-permeable belt. The method comprises moving the air-permeable belt along a rotating and perforated cylinder covering, and sealing a stationary pressure area inside the cylinder covering with at least one flat-shaped sealing element non-contactingly disposed along a circumferential portion of an inner wall of the cylinder covering.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The invention will now be described by way of exemplary embodiments with reference to the accompanying drawings, in which:

[0033] Fig. 1: shows a schematic cross section of a suction cylinder comprising two sealing surfaces; and

[0034] Fig. 2: shows the cross section of a suction cylinder comprising a single continuous sealing element.

#### DETAILED DESCRIPTION OF THE INVENTION

[0035] As depicted in Fig. 1, the cylinder is a suction cylinder having a rotatable cylinder covering 1 comprising open volumes (e.g., perforations). The cylinder is like those utilized in paper machines, in particular in the sheet forming section, in the press section, and in the drying section.

[0036] The suction cylinder is embraced by an air-permeable belt 3, such as, for example, a screen or a felt or a belt consisting of another material, and by the web of fibrous material 2

located outside. The embracing area is adjoined by a low pressure area within the cylinder that is formed by a fixed pressure compartment 4 which is open to the cylinder covering 1. The inside of the pressure compartment 4 is connected to a low pressure source.

**[0037]** To minimize air leakage, the pressure compartment 4 is connected from both sides to sealing elements 5, 6, each of which preferably extends along large parts of the inner wall of the cylinder covering 1 without being in direct contact with it. The sealing elements 5, 6 cover, for example, one quarter or one third of the inner wall of the cylinder covering 1; however, in a further embodiment, they can also be only a few millimeters long.

**[0038]** The sealing elements 5, 6 are disposed at a preferably short distance, for example of less than one millimeter, from the cylinder covering 1, to prevent air leakage into the pressure compartment 4 as far as possible. The sealing elements 5, 6 are respectively connected to the pressure compartment 4 by holding elements 7, 8.

**[0039]** The holding elements 7, 8 extend, for example, in an axial direction along the complete length of the suction cylinder and are mounted at the front side. However, the holding elements can also be mounted exclusively at the front side, so that the sealing elements 5, 6 are fastened in a “free floating” manner.

**[0040]** The sealing elements 5, 6 can, however, also be fastened to the holding elements 7, 8 by joints to enable them to be pivoted.

**[0041]** Additionally or alternatively, it is provided that the sealing elements 5, 6 are fastened on adjusting elements 9, 10 and 11, 12, respectively. The sealing elements 5, 6 may be bent inwards from their respective ends by the adjusting elements 9, 10, 11, 12, which are slidable in the direction of the depicted double arrows A, B, C and D. The adjusting elements 9, 10,

11, 12 are fastened, like the pressure compartment 4, to a (not shown) longitudinal axis or to the front side. Instead of the adjusting elements 9, 10, 11, 12, adjusting elements may also be mounted on other locations of the sealing elements 5, 6.

**[0042]** In a further embodiment of the suction cylinder, depicted in Fig. 2, there is a single sealing element 13, which covers almost the entire inner wall of the cylinder covering and is fastened to holding elements 14, 15. Only the embracing area of the cylinder covering 1 comprising the web of fibrous material 2 is not covered with the sealing element 13. As a result of the low pressure available in the entire inner area of the suction cylinder covered by the sealing element 13, moisture is withdrawn from the web of fibrous material 2 and/or the web of fibrous material 2 is pulled toward belt 3.

**[0043]** For this reason, in this embodiment of the invention a separate pressure compartment is no longer required to provide a zone adjoining the embracing area with a low pressure zone within the suction cylinder. This embodiment in particular is thus characterized by the simplicity of its construction.